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A QUALITATIVE STUDY OF THE NODULATING ABILITY OF LEGUME SPECIES: LIST 3

N. Grobbelaar and Brenda Clarke

(*Margaretha Mes Institute for Plant Physiology and Biochemistry, University of Pretoria*)

Abstract

184 species of legumes indigenous to Southern Africa were examined for root nodules. Eleven of these (two belonging to the Mimosoideae, seven to the Caesalpinioideae and two to the Papilionatae) were consistently found to be without root nodules. Of the listed species, 141 had apparently not previously been examined for their ability to produce root nodules.

Uittreksel

'N KWALITATIEWE STUDIE VAN DIE VERMOË VAN PEULPLANTSOORTE OM WORTEL-KNOPPIES TE VORM: LYS 3

184 peulplantsoorte wat inheems aan suidelike Afrika is, is vir die aanwesigheid van wortelknoppies ondersoek. Op elf spesies (2 lede van die Mimosoideae, sewe van die Caesalpinioideae en twee van die Papilionatae) is deurgaans geen knoppies aangetref nie. 141 van die gelyste plantsoorte is skynbaar nog nie van te vore vir wortelknoppies ondersoek nie.

Introduction

Apart from reports by Mostert (1955), Grobbelaar et al. (1967) and Grobbelaar and Clarke (1972), little is known about the nodulating ability of the 1 400-odd legume species (Phillips, 1951) that are indigenous to the Republic of South Africa, South West Africa, Botswana, Lesotho and Swaziland.

In an attempt to remedy this state of affairs a long-term survey was initiated at this laboratory some years ago and the present paper presents information obtained since the previous report was published by Grobbelaar and Clarke (1972).

Procedure

The procedure was identical with that published earlier in greater detail (Grobbelaar et al. 1967). Where possible, plants were examined in the field for root nodules. In other cases plants were grown from seed in pots containing nitrogen-poor media and their roots were examined periodically for nodules. If nodules did not form within a reasonable time, the substrate was enriched with *Rhizobium* suspensions from available cultures and/or with soil from the natural habitat of the species when this was possible.

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Annuals which failed to nodulate in at least three consecutive pot trials and perennials which did not nodulate within at least two years, were regarded as not being able to nodulate under local conditions.

In the case of species that were grown from seed in the laboratory, it was generally noted whether the germination was epigeal or hypogeal and whether a plumular hook developed during germination in the dark. Herbarium voucher specimens were prepared of all species tested. The specimens were identified at the Botanical Research Institute, Pretoria and deposited in the herbarium of the Department of General Botany, University of Pretoria.

Prof. and Mrs. Allen of the University of Wisconsin, U.S.A., have been compiling a card index of all available data regarding the nodulation of legumes for many years. The results of the present investigation are therefore regularly transmitted to them and they in turn indicate through personal correspondence whether other reports (published or personal) are available regarding the nodulating ability of the species concerned.

Results and Discussion

The species on which information is provided are listed in Table 1. The present list contains only species which are indigenous to the Republic of South Africa, South West Africa, Botswana, Lesotho and/or Swaziland.

Of the 184 species listed in Table 1, eleven were consistently found to be without root nodules. Two of these (*Acacia ataxacantha* and *Entada spicata*) belong to the Mimosoideae and apparently were not previously examined for nodulation. Seven of the eleven species from the Caesalpinioideae that were examined consistently lacked root nodules. Of these *Burkea africana*, *Bauhinia kirkii* and *Cassia petersiana* apparently were not previously examined for nodulation. At least one negative report on the nodulation of the other four species was recorded by the Allens previous to the present study. These reports pertained to *Schotia brachypetala*, *Bauhinia tomentosa*, *Cassia tomentosa* and *Cordyla africana*. Only two of the species listed under the Papilionatae were consistently found to be without root nodules. These were *Calpurnia aurea* ssp. *aurea* and *Virgilia divaricata*, neither of which appears to have been examined previously for nodulation. It is instructive to note that of the 184 species listed in Table 1, 141 species apparently were not previously examined for nodulation. Of the 43 species about which the Allens did have earlier reports, it is only our report on *Baphia massaiensis* ssp. *obovata* which does not agree with the earlier reports. In this particular case only one earlier report (unpublished) reached the Allens and this report suggested that *Baphia massaiensis* ssp. *obovata* probably does not normally nodulate.

Of the 46 species for which germination characteristics are provided in Table 1, 43 were found to be epigeal. Of these 26 produced a plumular hook whilst 8 did not. Two of the 3 species that germinated in a hypogeal fashion formed a plumular hook.

TABLE 1.

List of Indigenous Legume species examined for Nodulation.

Plant species[1]	Herbarium specimen number[2]	Nodulation		Germination[5]
		Present study[3]	Allen's records[4]	
MIMOSOIDEAE				
Ingeae Benth.				
Albizia adianthifolia (Schum.) Wight . .	25287	+c	C	
A. brevifolia Schinz	16941	+c	C	E+
A. forbesii Benth.	16507	+c	C	E+
Acacieae Benth.				
Acacia ataxacantha DC.	16968	−c, f	C	E+
A. borleae Burtt Davy	16914	+c	C	E−
A. erubescens Welw.	17737	+c	C	E−
A. exuvialis Verdoorn	19436	+c	C	E+
A. fleckii Schinz	17420	+c	A	E+
A. gerrardii Benth.	16510	+c	C	E
A. grandicornuta Gesner	17728	+c	C	E+
A. kraussiana Meisn. ex Benth. . . .	19169	+f	C	
A. luederitzii Engl. var. retinens (Sim.) Ross & Brenan	16509	+c	C	E
A. mellei Verdoorn	17436	+c	C	E+
A. nigrescens Oliv.	16216	+c	A	E−
A. permixta Burtt Davy.	17735	+c	C	E−
A. rehmanniana Schinz	17734	+c	C	E−
A. senegal (L.) Willd var. leiorhachis Brenan.	17725	+c	C	E+
A. senegal (L.) Willd var. rostrata Brenan .	17733	+c	C	E+
A. swazica Burtt Davy	17738	+c	C	E−
A. tenuispina Verdoorn	17746	+c	C	E+
A. xanthophloea Benth..	17730	+c	A	E−
Adenanthereae Benth.				
Dichrostachys cinerea (L.) Wight & Arn. ssp. africana Brenan & Brummit var. africana sens. lat.	19168	+c	C	E+
D. cinerea (L.) Wight & Arn. ssp. nyassana (Taub.) Brenan	23755	+c	C	
Piptadenieae Benth.				
Entada spicata (E. Mey.) Druce . . .	16885	−c, f	C	E+
CAESALPINIOIDEAE				
Dimorphandreae Benth.				
Burkea africana Hook.	16232	−c	C	E−
Amherstieae Benth.				
Schotia brachypetala Sond..	16492	−c	B	E+
Bauhinieae Benth.				
Bauhinia kirkii Oliv..	17552	−c	C	
B. tomentosa L.	25652	−c	B	E
Cassieae Benth.				
Cassia biensis (Steyaert) Mendonca & Torre	22819	+f	A	
C. comosa Vogel.	20725	+f	A	

Plant species[1]	Herbarium specimen number[2]	Nodulation		Germination[5]
		Present study[3]	Allen's records[4]	
Cassia kirkii Oliv.	19397	+c	C	E
C. petersiana Bolle	16924	−c	C	
C. plumosa (E. Mey.) Vogel	20732	+f	C	
C. tomentosa L.	25660	−c	B	
Swartzieae DC				
Cordyla africana Lour.	23851	−c	B	H
PAPILIONATAE				
Sophoreae Spreng				
Calpurnia aurea (Ait.) Benth. ssp. aurea	20632	−c	C	E−
Virgilia divaricata R. S. Adamson	19365	−c	C	
Baphia massaiensis Taub. ssp. obovata (Schinz.) Brummitt	25841	+c	B	
Podalyrieae Benth.				
Cyclopia falcata (Harv.) Kies	24381	+f	C	
C. genistoides (L.) R. Br.	22953	+f	C	
C. maculata (Andr.) Kies	16597	+f, c	C	E
C. montana Hofm. & Phill.	22907	+f	C	
Podalyria cuneifolia Vent	17743	+c	C	
P. myrtillifolia Willd	16813	+f	C	
Genisteae Bronn.				
Pleiospora cajanifolia Harv.	19191	+f	C	
Lotononis azurea Benth.	23876	+f	C	
L. calycina Benth. var. hirsutissima Duemmer	25304	+f	C	
L. cytisoides Benth.	22964	+c	C	E+
L. depressa Eckl. & Zeyh.	23653	+f	C	
L. divaricata Benth.	24830	+f	C	
L. macrosepala Conr.	25290	+f	C	
L. mucronata Conr.	24831	+f	C	
L. orthorrhiza Conr.	24834	+f	C	
L. platycarpa (Viv.) Pichi—Serm.	23622	+f	C	
L. sericoflora Dümm.	25307	+f	C	
L. stipulosa (Bak. f.) Schreiber	23623	+f	A	
L. tenella Eckl. & Zeyh.	23731	+f	C	
Pearsonia propinqua Duemmer.	16233	+c	C	E+
P. sessilifolia (Harv.) Duemmer ssp. filifolia (Bolus) Polhill	25303	+f	C	
P. sessilifolia (Harv.) Duemmer ssp. marginata (Schinz.) Polhill	27337	+f	C	
Aspalathus angustifolia (Lam.) R. Dahlgr. ssp. angustifolia	23872	+f	C	
A. cinerascens E. Mey.	23608	+f	C	
A. laricifolia Berg. ssp. laricifolia	16984	+f	C	
A. triquetra Thunb.	27225	+f	C	
Buchenroedera lotononoides Scott-Elliot	27336	+c	C	E+
Dichilus pilosus Conr.	17745	+c	C	
Melolobium adenodes Eckl. & Zeyh.	28901	+f	C	
M. obcordatum Harv.	28915	+f	C	
Crotalaria allenii Verdoorn	27334	+f	C	
C. brachycarpa Burtt Davy	23846	+f	C	
C. burkeana Benth.	25253	+f	C	
C. doidgeae Verdoorn	27863	+f	C	
C. dura Wood & Evans	27839	+f	C	
C. erimicola Bak. f.	19428	+c	C	

Plant species[1]	Herbarium specimen number[2]	Nodulation		Germination[5]
		Present study[3]	Allen's records[4]	
Crotalaria hispida Schinz	25282	+f	C	
C. laburnifolia L. ssp. australis (Bak. f.) Polhill	19182	+f	A	
C. maxillaris Klotzsch	25656	+c	A	E+
C. monteiroi Taub. ex Bak. f. var. galpinii Burtt Davy	20639	+c	C	E+
C. natalitia Meisn.	23890	+f	A	
C. ochroleuca G. Don.	19495	+c	A	E
C. pisicarpa Welw.	19380	+f	C	
C. podocarpa DC.	23660	+f	A	
C. recta Steud.	16802	+f	A	
C. schinzii Bak.	19381	+f	C	
C. spartea Baker	20621	+c	C	E
C. vasculosa Wallich	23871	+f	A	
C. virgultalis Burch.	22839	+f	C	
Argyrolobium collinum Eckl. & Zeyh.	23717	+f	C	
A. humile Phillips	23865	+f	C	
A. lancifolium Burtt Davy	22804	+f	C	
A. megarrhizum H. Bol.	27851	+f	C	
A. pilosum Harv.	28906	+f	C	
A. stipulaceum Eckl. & Zeyh.	19172	+f	A	
A. transvaalense Schinz	16795	+f	C	
Loddigesia oxalidifolia (Sims) Phillips	23679	+f	C	E+
Trifolieae Bronn.				
Trifolium africanum Ser. var. africanum	18281	+f	A	
Loteae Benth.				
Lotus discolor E. Mey.	16811	+f	C	
L. hispidus Desf.	17649	+f	A	
Galegeae Bronn.				
Indigofera acutisepala Conrath.	23843	+f	C	
I. adenocarpa E. Mey.	16963	+f	C	
I. costata Guill. & Perr. ssp. gonioides (Hochst. ex Bak.) Gillett	20600	+f	C	
I. costata Guill. & Perr. ssp. macra (E. Mey.) Gillett	19187	+f	C	
I. cuneifolia Eckl. & Zeyh.	23723	+f	C	
I. cylindrica DC.	21676	+c	C	
I. eriocarpa E. Mey.	28357	+f	C	
I. foliosa E. Mey.	24383	+f	C	
I. glaucescens Eckl. & Zeyh.	27341	+f	C	
I. hispida Eckl. & Zeyh.	27342	+c	C	
I. ingrata N. E. Br.	22885	+f	C	
I. longebarbata Engl.	23855	+f	C	
I. mischocarpa Schl.	23709	+f	C	
I. mollicoma N. E. Br.	23733	+f	C	
I. pauxilla N. E. Br.	23875	+f	C	
I. pongolana N. E. Br.	23644	+f	C	
I. ripae N. E. Br.	25300	+f	C	
I. schinzii N. E. Br..	23612	+f	C	
I. sessilifolia DC.	23720	+f	C	
I. sordida Benth.	27223	+f	C	
I. spinescens E. Mey.	23708	+f	C	
I. stricta L. f.	23678	+f	C	
I. subulata Vahl. ex Poir. var. subulata	28362	+f	C	

Plant species[1]	Herbarium specimen number[2]	Nodulation		Germination[5]
		Present study[3]	Allen's records[4]	
Indigofera tinctoria L.	21680	+c	A	E+
I. torulosa E. Mey.	23632	+f	C	
I. velutina E. Mey.	25650	+f	C	
I. vicioides Jaub. & Spach. var. vicioides	19435	+c	A	
Tephrosia aequilata Bak. ssp. australis Brummitt	16933	+f	C	
T. capensis (Jacq.) Pers. var. hirsuta Harv.	28927	+f	C	
T. contorta N. E. Br.	27224	+f	C	
T. cordata Hutch. & Burtt Davy	27227	+f	C	
T. elongata E. Mey. var. elongata	20908	+f	C	
T. elongata E. Mey. var. pubescens Harv.	28383	+f	C	
T. longipes Meisn. var. longipes	23756	+c	A	E+
T. lupinifolia (Burch.) DC.	23842	+f	C	
T. pseudocapitata H. M. Forbes	27833	+f	C	
T. purpurea Pers. ssp. leptostachya (DC.) Brummitt	19450	+c	A	E+
T. rhodesica Bak. f.	23663	+f	A	
T. villosa (L.) Pers.	19430	+c	A	E
T. vogelii Hook. f.	16929	+c	A	
Sesbania cinerascens Welw. ex Bak.	19185	+c	A	E+
S. coerulescens Harms	19189	+c	A	E+
S. sphaerosperma Welw.	19389	+c	C	
S. transvaalensis Gillett.	16564	+c	C	
Lessertia affinis Burtt Davy.	23700	+f	C	
L. stenoloba E. Mey.	18240	+c	C	
L. stricta Bolus	23857	+c	C	
Hedysareae DC.				
Smithia erubescens (E. Mey.) Bak. f.	19190	+f	C	
Desmodium natalitium Sond.	25659	+f	A	
D. salicifolium DC.	19478	+c	A	
Alysicarpus rugosus (Willd) DC. ssp. perennirufus J. Leonard	25265	+f	C	
Alysicarpus zeyheri Harv.	24374	+f	A	
Dalbergieae Bronn.				
Dalbergia melanoxylon Guill. & Perr.	19163	+f	A	
D. obovata E. Mey.	20737	+f	C	
Lonchocarpus capassa Rolfe	16500	+c	C	
Phaseoleae Bronn.				
Dumasia villosa DC.	16803	+f	C	
Glycine wightii (Wight & Arn.) Verdc. ssp. wightii var. longicauda (Schweinf.) Verdc.	19431	+c	A	E
Neorautanenia amboensis Schinz.	19371	+f	C	
N. ficifolia (Benth. ex Harv.) C. A. Sm.	23841	+f	C	
Erythrina caffra Thunb.	23764	+c	A	
E. lysistemon Hutch.	22478	+c	A	
E. zeyheri Harv.	25842	+c	C	
Canavalia maritima (Aubl.) Thouars	20728	+f	A	
Fagelia bituminosa (L.) DC.	17553	+f	C	
Rhynchosia ciliata (Thunb.) Druce	22871	+f	C	
R. cooperi (Harv. ex Bak. f.) Burtt Davy.	25274	+f	C	
R. longiflora Schinz.	23648	+f	C	
R. minima (L.) DC. var. minima	28925	+f	A	
R. pentheri Schltr. var. hutchinsoniana Burtt Davy	22903	+f	C	

Plant species[1]	Herbarium specimen number[2]	Nodulation		Germination[5]
		Present study[3]	Allen's records[4]	
Rhynchosia sublobata (Schum.) Meikle	22505	+c	C	H+
Eriosema cordatum E. Mey. var. cordatum	19180	+f	C	
Flemingia grahamiana Wight & Arn.	16938	+f	C	
Vigna angustifoliolata Verdc.	21480	+f	C	
V. davyi Bol.	25658	+f	C	
V. decipiens Harv.	25299	+f	C	
V. luteola (Jacq.) Benth.	28361	+f	A	
V. oblongifolia A. Rich.	19429	+c	C	E+
V. re tusa Walp.	27836	+f	A	
V. unguiculata (L.) Walp. ssp. dekindtiana (Harms.) Verdc.	25649	+f	C	
Dipogon lignosus (L.) Verdc.	19481	+c	A	H+
Dolichos angustifolius Eckl. & Zeyh.	23707	+f	C	
D. falciformis E. Mey.	25844	+f	C	
D. hastaeformis E. Mey.	23694	+f	C	
D. trilobus L. subsp. transvaalensis Verdc.	16583	+f	A	
Macrotyloma maranguense (Taub. Verdc.)	21492	+f	C	

1. Species are arranged alphabetically within genera. The genera are arranged according to the system of de Dalla Torre & Harms (1963).
2. Voucher specimens are kept in the herbarium of the Dept. of General Botany, University of Pretoria.
3. A "+" indicates that nodulation was observed and a "−" that nodulation was not observed during an observation period of at least two years. Plants studied at the laboratory are indicated by a "c" whereas species examined in the field are indicated by an "f".
4. The letters A, B and C refer to information obtained by private communication from Professor O. N. Allen, Department of Bacteriology, University of Wisconsin, U.S.A.
   A—nodulation previously observed
   B—species investigated previously but nodulation never observed
   C—species apparently not investigated previously for nodulation
5. "E" denotes epigeal and "H" hypogeal germination. The "+" or "−" indicates whether a plumular hook is formed during germination or not.

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